

## 1 Watt Audio Power Amplifier

### General Description

The LM4890 is an audio power amplifier primarily designed for demanding applications in mobile phones and other portable communication device applications. It is capable of delivering 1 watt of continuous average power to an 8Ω BTL load with less than 1% distortion (THD+N) from a 5V<sub>DC</sub> power supply.

Boomer audio power amplifiers were designed specifically to provide high quality output power with a minimal amount of external components. The LM4890 does not require output coupling capacitors or bootstrap capacitors, and therefore is ideally suited for mobile phone and other low voltage applications where minimal power consumption is a primary requirement.

The LM4890 features a low-power consumption shutdown mode, which is achieved by driving the shutdown pin with logic low. Additionally, the LM4890 features an internal thermal shutdown protection mechanism.

The LM4890 contains advanced pop & click circuitry which eliminates noises which would otherwise occur during turn-on and turn-off transitions.

The LM4890 is unity-gain stable and can be configured by external gain-setting resistors.

### Key Specifications

■ PSRR at 217Hz, V <sub>DD</sub> = 5V (Fig. 1)	62dB(typ.)
■ Power Output at 5.0V & 1% THD	1W(typ.)
■ Power Output at 3.3V & 1% THD	400mW(typ.)
■ Shutdown Current	0.1μA(typ.)

### Features

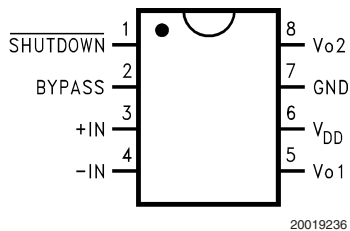
- Available in space-saving packages: micro SMD, MSOP, SOIC, and LLP
- Ultra low current shutdown mode
- BTL output can drive capacitive loads
- Improved pop & click circuitry eliminates noises during turn-on and turn-off transitions
- 2.2 - 5.5V operation
- No output coupling capacitors, snubber networks or bootstrap capacitors required
- Thermal shutdown protection
- Unity-gain stable
- External gain configuration capability

### Applications

- Mobile Phones
- PDAs
- Portable electronic devices

### Connection Diagrams (Continued)

#### Mini Small Outline (MSOP) Package

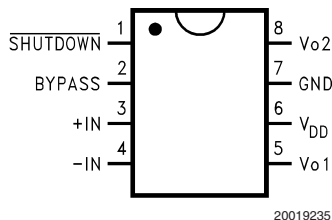


Top View

Order Number LM4890MM

See NS Package Number MUA08A

#### Small Outline (SO) Package

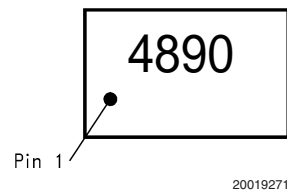


Top View

Order Number LM4890M

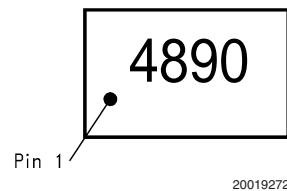
See NS Package Number M08A

#### MSOP Marking



Top View  
G - Boomer Family  
90 - LM4890MM

#### SO Marking



Top View  
XY - Date Code  
TT - Die Traceability  
Bottom 2 lines - Part Number

## Typical Application

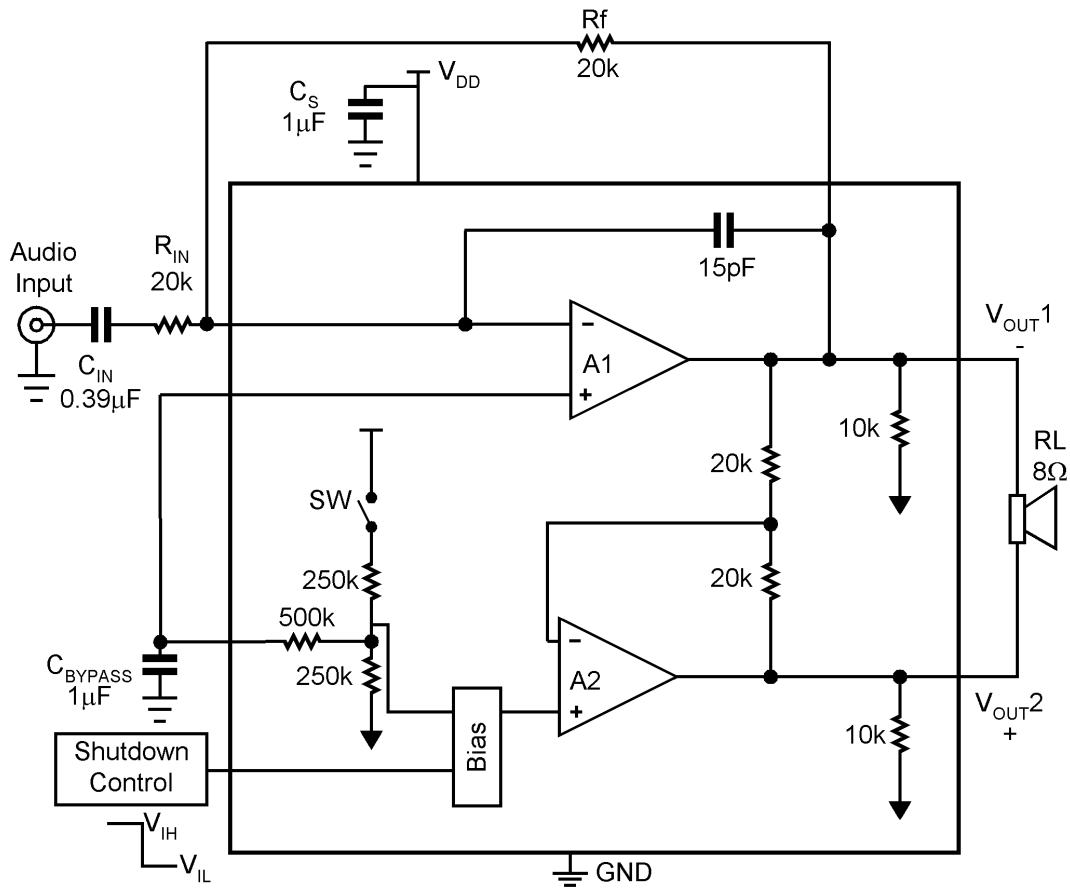


FIGURE 1. Typical Audio Amplifier Application Circuit

## Absolute Maximum Ratings (Note 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (Note 11)	6.0V
Storage Temperature	-65°C to +150°C
Input Voltage	-0.3V to $V_{DD} + 0.3V$
Power Dissipation (Note 3)	Internally Limited
ESD Susceptibility (Note 4)	2000V
Junction Temperature	150°C
Thermal Resistance	
$\theta_{JC}$ (SOP)	35°C/W
$\theta_{JA}$ (SOP)	150°C/W
$\theta_{JA}$ (8 Bump micro SMD, Note 12)	220°C/W

$\theta_{JA}$ (9 Bump micro SMD, Note 12)	180°C/W
$\theta_{JC}$ (MSOP)	56°C/W
$\theta_{JA}$ (MSOP)	190°C/W
$\theta_{JA}$ (LLP)	220°C/W

## Soldering Information

See AN-1112 "microSMD Wafers Level Chip Scale Package."

See AN-1187 "Leadless Leadframe Package (LLP)."

## Operating Ratings

### Temperature Range

$$T_{MIN} \leq T_A \leq T_{MAX} \quad -40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$$

$$\text{Supply Voltage} \quad 2.2V \leq V_{DD} \leq 5.5V$$

## Electrical Characteristics $V_{DD} = 5V$ (Notes 1, 2, 8)

The following specifications apply for the circuit shown in Figure 1 unless otherwise specified. Limits apply for  $T_A = 25^\circ\text{C}$ .

Symbol	Parameter	Conditions	LM4890		Units (Limits)
			Typical	Limit	
			(Note 6)	(Notes 7, 9)	
$I_{DD}$	Quiescent Power Supply Current	$V_{IN} = 0V, I_o = 0A$ , No Load	4	8	mA (max)
		$V_{IN} = 0V, I_o = 0A$ , 8 $\Omega$ Load	5	10	mA (max)
$I_{SD}$	Shutdown Current	$V_{SHUTDOWN} = 0V$	0.1	2.0	$\mu\text{A}$ (max)
$V_{SDIH}$	Shutdown Voltage Input High			1.2	V (min)
$V_{SDIL}$	Shutdown Voltage Input Low			0.4	V (max)
$V_{OS}$	Output Offset Voltage		7	50	mV (max)
$R_{OUT-GND}$	Resistor Output to GND (Note 10)		8.5	9.7	k $\Omega$ (max)
				7.0	k $\Omega$ (min)
$P_o$	Output Power (8 $\Omega$ )	THD = 2% (max); f = 1 kHz	1.0	0.8	W
$T_{WU}$	Wake-up time		170	220	ms (max)
$T_{SD}$	Thermal Shutdown Temperature		170	150	$^\circ\text{C}$ (min)
				190	$^\circ\text{C}$ (max)
THD+N	Total Harmonic Distortion + Noise	$P_o = 0.4$ Wrms; f = 1kHz	0.1		%
PSRR	Power Supply Rejection Ratio (Note 14)	$V_{ripple} = 200\text{mV}$ sine p-p Input Terminated with 10 ohms to ground	62 (f = 217Hz) 66 (f = 1kHz)	55	dB (min)
$T_{SDT}$	Shut Down Time	8 $\Omega$ load	1.0		ms (max)

## Electrical Characteristics $V_{DD} = 3V$ (Notes 1, 2, 8)

The following specifications apply for the circuit shown in Figure 1 unless otherwise specified. Limits apply for  $T_A = 25^\circ\text{C}$ .

Symbol	Parameter	Conditions	LM4890		Units (Limits)
			Typical	Limit	
			(Note 6)	(Notes 7, 9)	
$I_{DD}$	Quiescent Power Supply Current	$V_{IN} = 0V, I_o = 0A$ , No Load	3.5	7	mA (max)
		$V_{IN} = 0V, I_o = 0A$ , 8 $\Omega$ Load	4.5	9	mA (max)
$I_{SD}$	Shutdown Current	$V_{SHUTDOWN} = 0V$	0.1	2.0	$\mu\text{A}$ (max)
$V_{SDIH}$	Shutdown Voltage Input High			1.2	V (min)
$V_{SDIL}$	Shutdown Voltage Input Low			0.4	V (max)
$V_{OS}$	Output Offset Voltage		7	50	mV (max)
$R_{OUT-GND}$	Resistor Output to Gnd (Note 10)		8.5	9.7	k $\Omega$ (max)
				7.0	k $\Omega$ (min)
$T_{WU}$	Wake-up time		120	180	ms (max)

## Electrical Characteristics $V_{DD} = 3V$ (Notes 1, 2, 8)

The following specifications apply for the circuit shown in Figure 1 unless otherwise specified. Limits apply for  $T_A = 25^\circ\text{C}$ . (Continued)

Symbol	Parameter	Conditions	LM4890		Units (Limits)
			Typical	Limit	
			(Note 6)	(Notes 7, 9)	
$P_o$	Output Power (8 $\Omega$ )	THD = 1% (max); f = 1kHz	0.31	0.28	W
$T_{SD}$	Thermal Shutdown Temperature		170	150 190	$^\circ\text{C}(\text{min})$ $^\circ\text{C}(\text{max})$
THD+N	Total Harmonic Distortion + Noise	$P_o = 0.15\text{Wrms}$ ; f = 1kHz	0.1		%
PSRR	Power Supply Rejection Ratio (Note 14)	$V_{\text{ripple}} = 200\text{mV}$ sine p-p Input terminated with 10 ohms to ground	56 (f = 217Hz) 62 (f = 1kHz)	45	dB(min)

## Electrical Characteristics $V_{DD} = 2.6V$ (Notes 1, 2, 8)

The following specifications apply for for the circuit shown in Figure 1 unless otherwise specified. Limits apply for  $T_A = 25^\circ\text{C}$ .

Symbol	Parameter	Conditions	LM4890		Units (Limits)
			Typical	Limit	
			(Note 6)	(Notes 7, 9)	
$I_{DD}$	Quiescent Power Supply Current	$V_{IN} = 0V$ , $I_o = 0A$ , No Load	2.6		mA (max)
$I_{SD}$	Shutdown Current	$V_{SHUTDOWN} = 0V$	0.1		$\mu\text{A}$ (max)
$P_o$	Output Power (8 $\Omega$ ) Output Power (4 $\Omega$ )	THD = 1% (max); f = 1 kHz THD = 1% (max); f = 1 kHz	0.2 0.22		W W
THD+N	Total Harmonic Distortion + Noise	$P_o = 0.1\text{Wrms}$ ; f = 1kHz	0.08		%
PSRR	Power Supply Rejection Ratio (Note 14)	$V_{\text{ripple}} = 200\text{mV}$ sine p-p Input Terminated with 10 ohms to ground	44 (f = 217Hz) 44 (f = 1kHz)		dB

## External Components Description (Figure 1)

Components	Functional Description	
1.	$R_{IN}$	Inverting input resistance which sets the closed-loop gain in conjunction with $R_f$ . This resistor also forms a high pass filter with $C_{IN}$ at $f_c = 1/(2\pi R_{IN}C_{IN})$ .
2.	$C_{IN}$	Input coupling capacitor which blocks the DC voltage at the amplifier's input terminals. Also creates a highpass filter with $R_{IN}$ at $f_c = 1/(2\pi R_{IN}C_{IN})$ . Refer to the section, <b>Proper Selection of External Components</b> , for an explanation of how to determine the value of $C_{IN}$ .
3.	$R_f$	Feedback resistance which sets the closed-loop gain in conjunction with $R_{IN}$ .
4.	$C_S$	Supply bypass capacitor which provides power supply filtering. Refer to the section, <b>Power Supply Bypassing</b> , for information concerning proper placement and selection of the supply bypass capacitor, $C_{BYPASS}$ .
5.	$C_{BYPASS}$	Bypass pin capacitor which provides half-supply filtering. Refer to the section, <b>Proper Selection of External Components</b> , for information concerning proper placement and selection of $C_{BYPASS}$ .

## Application Information (Continued)

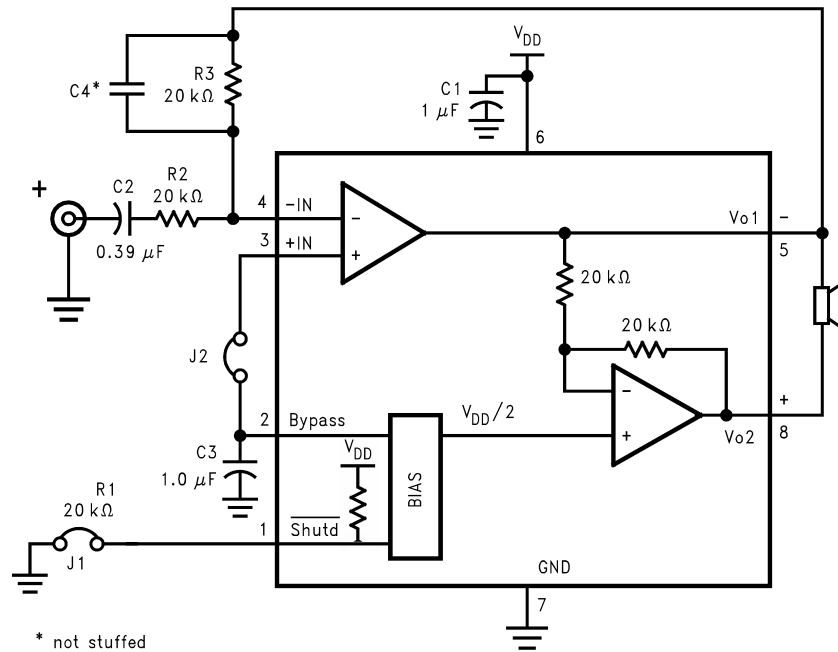
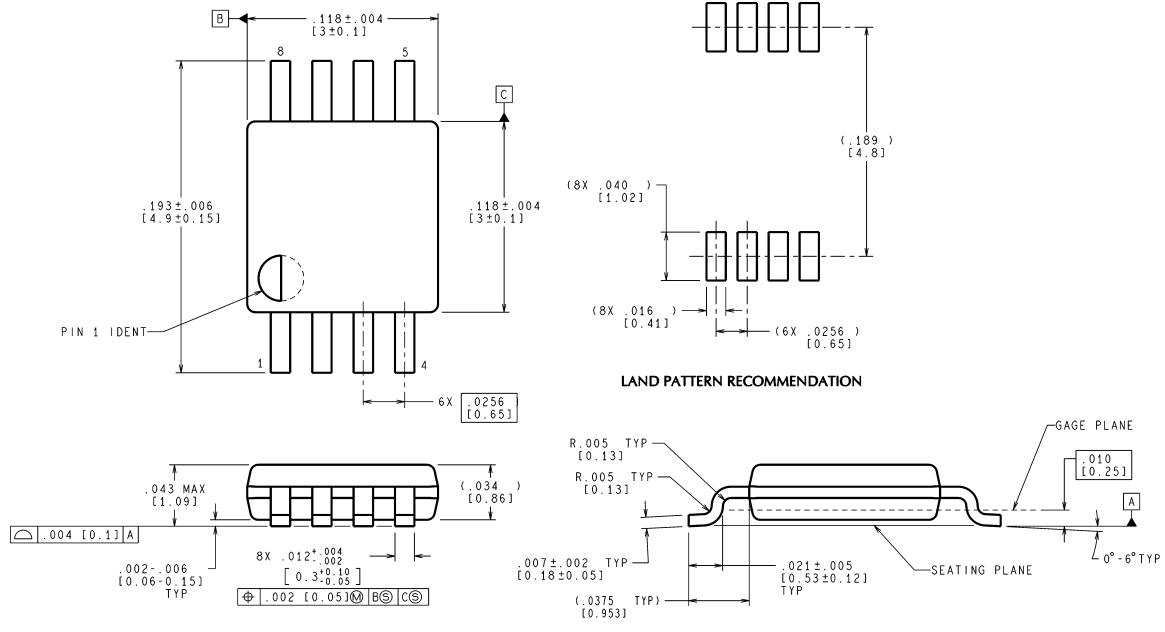


FIGURE 5. REFERENCE DESIGN BOARD and PCB LAYOUT GUIDELINES - MSOP & SO Boards

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



MSOP

MUA08A (Rev E)